ASHRAE/ IESNA Standard 90.1

Future 90.1 Economic Analysis Methods

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Current Status

- Envelope
- Lighting
- HVAC
- ECB

Objectives *(from Envelope perspective)*

- Improve accuracy
- Increase stringency
- Better address special cases
- Better address quality & design issues

A 4 Phase Optimization Program

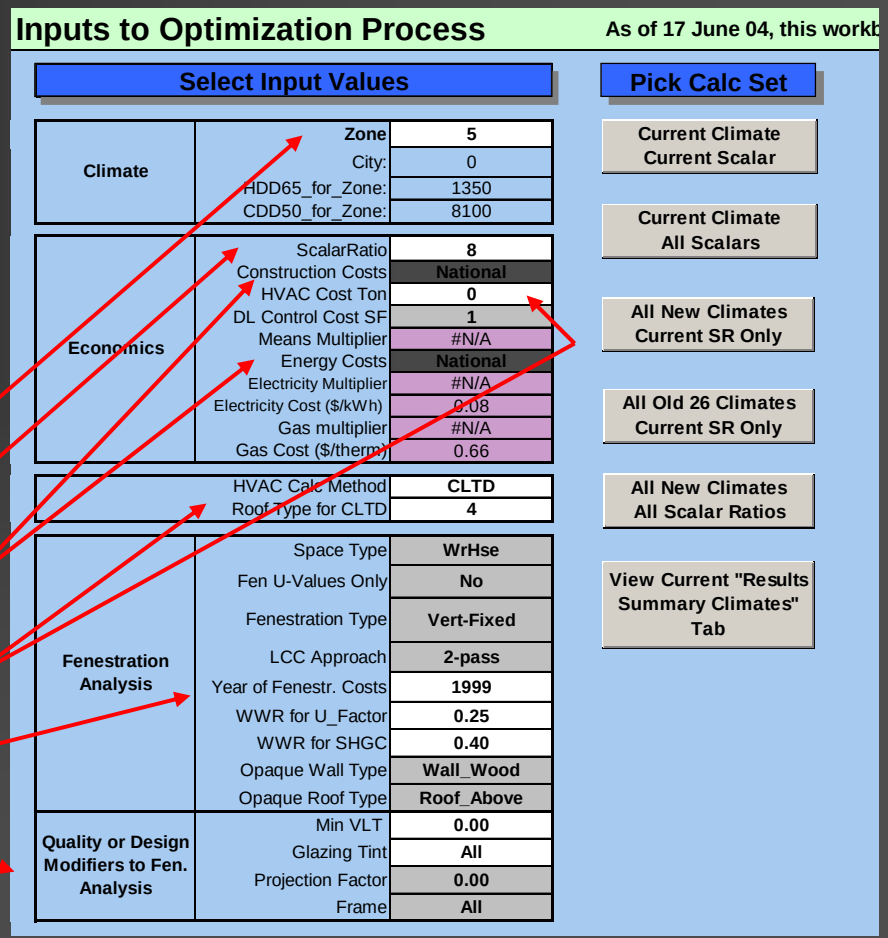
- Long Range Program
  - Toward High performance buildings (even zero-energy buildings)
  - Toward integration with environmental rating systems (e.g. green building rating system)
- Envelope focus
  - Get one's own house in order 1st
  - But would welcome broader application

The 4 Phases

1. Refine Current Optimization Method
2. Refine underlying analysis methods
3. Add Advanced technologies
4. Advanced optimization methods

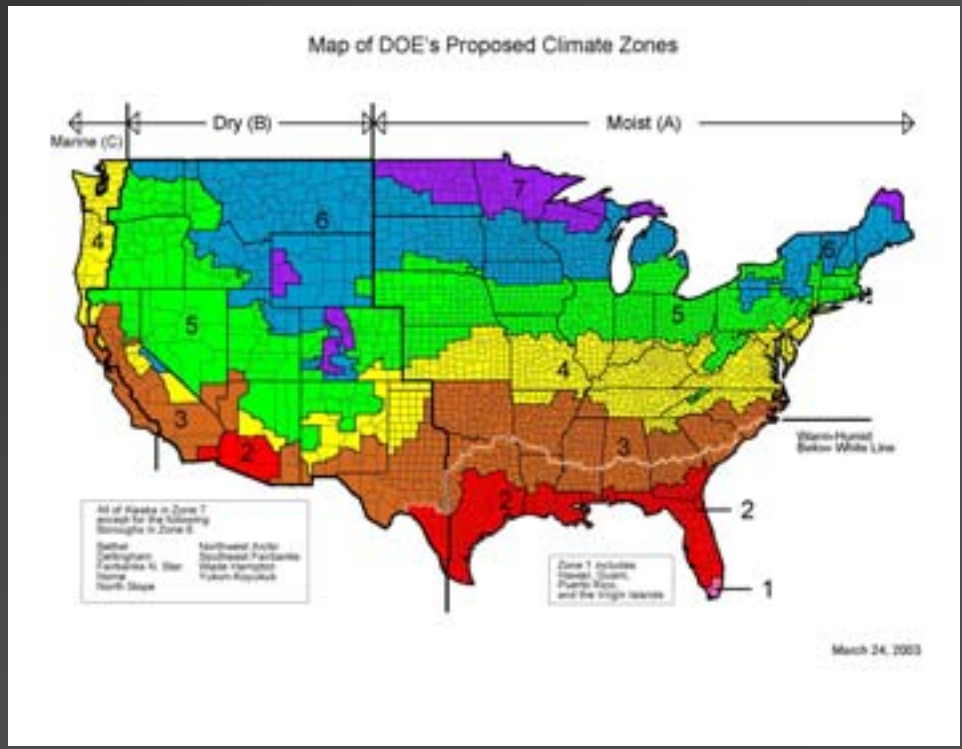
Ph. 1 – Refine Current EA Method

- Objective: to obtain @ “20%” savings in energy use from envelope.
- Refinements:
  a. New 8 zones / old 26 zones
  b. Economic variables
  c. Costs – national vs. regional
  d. Envelope Impacts on HVAC
  e. Update fen. costs / options
  f. Quality & Design Issues



Ph. 1a – New 8 zones / old 26 zones

- New addendum approved to go from 26 to 8 climate zones
- Can compare impacts of sets of zones



Ph. 1b – Impacts of changing “scalar”

- Examining impacts on envelope criteria from systematic changes in economic objects
- Scalar 8 to 24

Ph. 1c - National & Regional Costs

- Fuel & Construction Costs
- National Fuel costs have been used for 90.1-1999 / 2001
  - A blended cost of gas and electric
- We are exploring impacts of using regional costs
  - Preliminary analyses uses multipliers on national average costs
  - Fuel multipliers derived from the *Tariff Analysis Project (TAP)*
  - Construction cost multipliers derived from collected data.
  - So far have used simplified zones to apply multipliers

Ph. 1d – Envelope Impacts on HVAC Sizing Costs

- Includes:
  - All previous analyses ignored envelope impacts on HVAC sizing.
  - Current analysis accounts for incremental differences in HVAC cost due to sizing impacts
  - Preliminary analysis using CLTD method

Fenestration SCL Values

(Zone Type A)

SCL_Fen_ZoneA_24

Glass Face	SCL, Zone Type A, 24 deg pg. 8.34									
	8	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
N	36	36	38	40	42	42	40	38	39	43
E	177	180	154	107	68	54	46	40	33	25
S	23	30	35	40	43	43	40	37	32	24
W	23	30	35	39	41	67	116	160	186	184

SCL_Fen_ZoneA_36

Glass Face	SCL, Zone Type A, 36 deg pg. 8.35									
	8	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
N	28	32	36	39	40	41	39	36	32	33
E	184	182	155	107	67	54	45	39	33	26
S	24	36	53	70	80	79	68	52	38	29
W	24	30	35	38	40	66	115	159	188	191

SCL_Fen_ZoneA_40

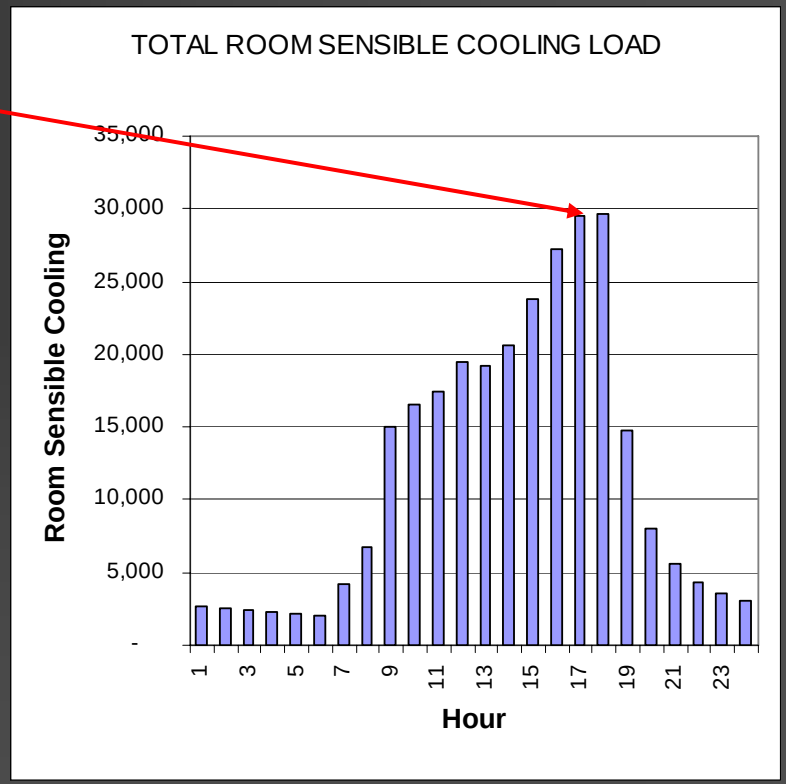
Glass Face	SCL, Zone Type A, 40 deg pg. 28.50									
	8	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
N	28	32	35	38	40	40	39	36	31	31
E	185	183	154	106	67	53	45	39	33	26
S	25	41	64	85	97	96	84	63	42	31
W	24	30	35	38	40	65	114	158	187	192

SCL_Fen_ZoneA_48

Glass Face	SCL, Zone Type A, 48 deg pg. 8.36									
	8	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
N	27	31	34	37	38	38	37	35	31	27
E	188	182	153	104	65	51	43	38	32	27
S	30	58	90	116	130	130	116	88	56	37
W	24	30	34	36	38	64	112	156	186	193

Ph. 1d – Envelope Impacts on HVAC Sizing Costs (cont.)

- Includes:
  - Some exploration of using RTS method
  - This is not completed



Ph. 1e – Update Fenestration Costs

- All construction costs are from 1990s
- Knew important fenestration cost changes had occurred
- Analysis of costs in 2003
- Major reductions in cost of selective low-e

		Technical Data						Costs		
ID Number	Frame/Glass Construction	Vertical U-Factor	Skylight, with Curb, Glass, U-Factor	Skylight, w/o Curb, All, U-Factor	SHGC	VLT	VLT/ SHGC	1999 Initial Cost ($/sf)	2003 Initial Cost ($/sf)	1999 cost less 2003 cost
1106	Mtl/HptMpr	1.26	1.58	1.36	0.40	0.38	0.95	$3.61	$99.00	($95.39)
2170	Mtl/ClrSue-Std-ClrSue	0.57	0.82	0.68	0.40	0.55	1.38	$7.83	$99.00	($91.17)
2313	Brk/Hpt-Std-Clr	0.62	0.85	0.70	0.40	0.54	1.35	$7.31	$7.22	$0.09
2317	Brk/ClrSbe-Std-Clr	0.48	0.73	0.58	0.40	0.45	1.13	$8.32	$7.22	$1.11
2332	Brk/Grn-Std-ClrSpe	0.48	0.73	0.58	0.40	0.55	1.38	$8.83	$7.22	$1.61
2413	Brk/Hpt-Ins-Clr	0.59	0.81	0.67	0.40	0.54	1.35	$8.35	$7.71	$0.64
2417	Brk/ClrSbe-Ins-Clr	0.44	0.69	0.55	0.40	0.45	1.13	$9.36	$7.71	$1.65
2432	Brk/Grn-Ins-ClrSpe	0.44	0.69	0.55	0.40	0.55	1.38	$9.87	$7.71	$2.16

Ph. 1f - Quality / Design Issues

- Examples being considered
  - Minimum VLT
  - Tinted glazing – impacts of constraining or eliminating from optimization
    - Tinted glass not used in SP-102 SHGC results
  - External shading (projection factors)
  - Frames – impacts of constraining or eliminating certain frame types from optimization

Ph. 2 – Refine underlying analysis methods

- Underlying Energy analysis methodology is about 10 years old
- Does not incorporate recent techical advances
- Need to re-do the underlying energy analysis
- Use latest tools, methods, technologies, e.g.,
  - Energy Plus
  - GenOpt
  - Consider replacing regression equations with direct optimization using multiple simulation runs

Ph. 2 – Refinements being considered (part 1)

1. Improve weighting factors
2. Angle-dependent SHGC to replace old SC
3. Combined analysis of U and SHGC
4. Climate-dependent external shading credit
5. Refine Daylighting analysis
6. Better integration of inter-system impacts
   - Daylighting
   - HVAC sizing
   - Peak load & annual energy

Ph. 3 – Include Advanced technologies

- Will soon be at limit of current technologies
- Add advanced technologies to mix
- Toward High performance buildings
- Toward zero-energy Buildings
- Include more system integration in analysis

Ph. 3 – Include Advanced technologies

- Examples
  - Advanced envelope with integrated Daylighting
  - Active envelopes / shading systems
  - Active envelopes / ventilation systems
  - Etc.

Ph. 4 – Advanced Optimization Approaches

- Integrate with environmental rating systems
- Vector analyses across multiple factors, e.g.
  - Annual energy
  - Peak
  - Visual and thermal quality
  - Material recycling
- Climate change impacts on buildings
  - E.g. Future Washington DC
    - HDD x (0.6 or 0.7)
    - CDD X (2.0 or 3.0)

Climate Predictions in 25 Cities from GCM Modeling of 4 Climate Change Scenarios

Projected climate changes for 4 CC scenarios defined by the IPCC WG III:

A1F1 rapid economic and population growth, fossil intensive energy sources, CO_2 concentration 970 ppm

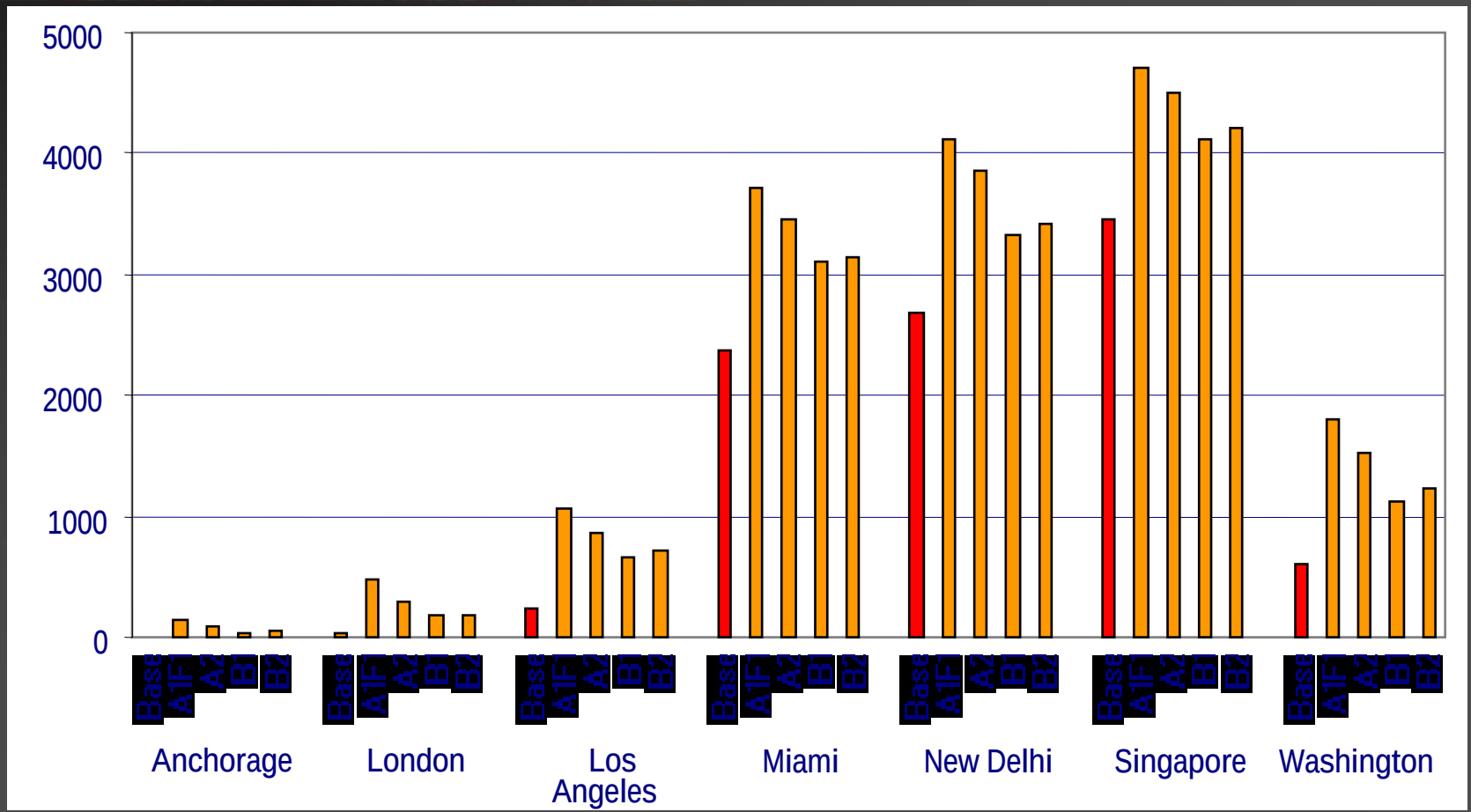
A2 continuous population growth, but fragmented economic growth, CO_2 concentration 830 ppm

B1 population peaks in mid-21st century, economic change towards service and information technologies and use of clean and resource-efficient technologies, CO_2 conc. 550 ppm

B2 local solutions to economic, social and environmental sustainability; internediate population and economic development, CO_2 concentration 600 ppm

reference on scenarios: Intergovernmental Panel on Climate Change, 2000.
source of climate prediction data: Dru Crawley, US DOE, 2004.
source of slide: Joe Huang, LBNL, 2004

Cooling Degree Days 18C for 7 Selected Cities under four IPCC Scenarios



source of slide: Joe Huang, LBNL, 2004

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Q & A

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